NPDES Permit Renewal Issues
Drinking Water Supply and Public Health
Sacramento Regional County Sanitation District
Sacramento Regional Wastewater Treatment Plant
14 December 2009

Background/Purpose

Central Valley Regional Water Quality Control Board (Central Valley Water Board) staff is currently developing the National Pollutant Discharge Elimination System (NPDES) permit renewal for the Sacramento Regional County Sanitation District's (SRCSD) Sacramento Regional Wastewater Treatment Plant discharge to the Sacramento River. The proposed permit renewal is scheduled to be considered by the Central Valley Water Board for adoption in 2010. The existing NPDES permit (Waste Discharge Requirements Order No. 5-00-188[1]) regulates the discharge of secondary treated municipal wastewater up to 181 million gallons per day (mgd) to the Sacramento River, within the Sacramento-San Joaquin Delta (Delta). For the proposed permit renewal, the SRCSD is requesting an increase of its permitted average dry weather discharge flow from 181 mgd to 218 mgd.

The purpose of this issue paper is to identify issues and provide information regarding the NPDES permitting requirements necessary to protect the municipal and domestic supply (MUN) beneficial use of the Delta (e.g., drinking water supply issues). Issues regarding public health protection due to public contact with treated wastewater are also discussed in this issue paper (e.g., disinfection issues). In this issue paper we are requesting public comments and/or data from interested stakeholders to assist Central Valley Water Board staff in developing NPDES permit requirements for the surface water discharge.

Setting

Sacramento Regional Wastewater Treatment Plant (SRWTP) - The SRWTP is a publicly owned treatment works (POTW) that serves about 1.3 million people in the greater Sacramento area, including the Cities of Folsom, Rancho Cordova, West Sacramento, Sacramento, Elk Grove and Citrus Heights, and urbanized areas of Sacramento County. The SRWTP is located in Elk Grove and discharges disinfected secondary treated wastewater to the Sacramento River immediately below the Freeport Bridge. The existing secondary treatment at the facility consists of preliminary screening and grit removal, primary sedimentation, a pure oxygen activated sludge treatment system, and chlorination and dechlorination for disinfection. The current permitted capacity of the SRWTP is 181 mgd (average dry weather flow) and current flows average 141 mgd. The SRCSD has requested an increase of the permitted average dry weather flow from 181 mgd to 218 mgd to accommodate future growth in the Sacramento area. Because SRWTP is a regional facility, SRCSD's current permitted discharge (181 mgd) represents nearly 60% of all POTW discharges to the Delta as shown in Figure 1, below.

[1] Order No. 5-00-188 was adopted 4 August 2000 and expired 1 August 2005. The SRCSD submitted a complete Report of Waste Discharge and application for renewal on 1 February 2005 The expired permit has been administratively extended until the renewe d permit is adopted in accordance with Federal Regulations (40 CFR 122.6)

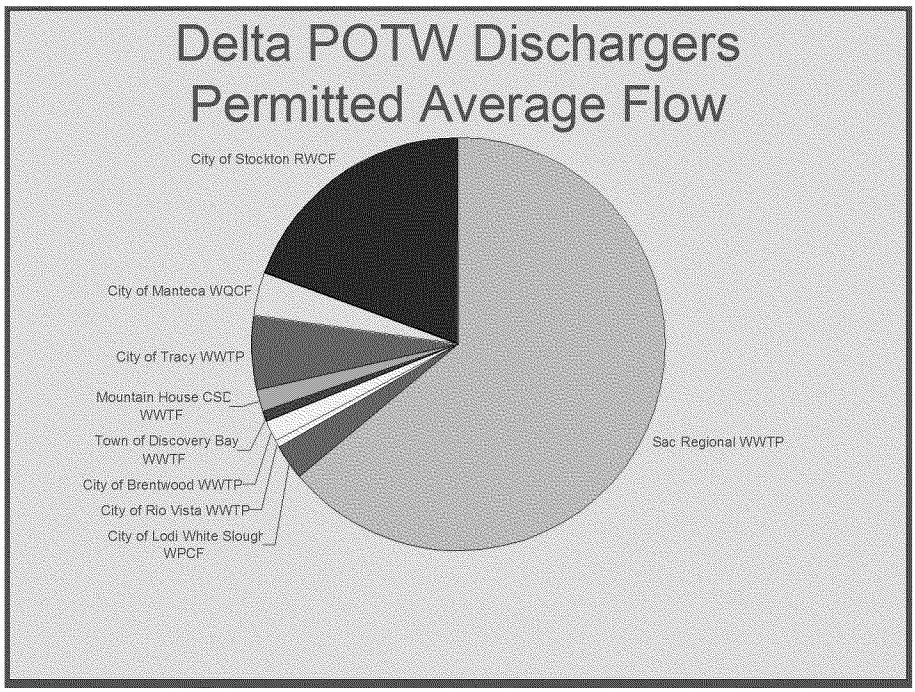


Figure 1 – Delta POTW Dischargers Permitted Average Flow

The secondary treated effluent is discharged through a diffuser on the bottom of the Sacramento River where the river surface width is approximately 600 feet wide. The outfall diffuser is approximately 300 feet long with 74 ports and is placed perpendicular to the river flow. At times, due to tidal activity during low flows, the river flows in the reverse direction northeast towards the City of Sacramento.

The Delta - The discharge is to the Sacramento River within the Delta. The Delta comprises over 700 miles of interconnected waterways and encompasses 1,153 square miles. The Delta is home to over two hundred eighty species of birds and more than fifty species of fish, making it one of the most ecologically important aquatic habitats in the State. Drinking water for over 25 million Californians is pumped from the Delta via the State Water Project, Central Valley Water Project, and local water intakes. The Delta supports California's trillion dollar economy with $27 billion annually for agriculture. Additionally, the Delta has 12 million user days for recreation each year.

Beneficial Uses and Water Quality Objectives - The Central Valley Water Board adopted the Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan). The Basin Plan designates beneficial uses for the Sacramento River and the Delta. The Basin Plan includes, in part, the following beneficial uses for the Delta: municipal and domestic water supply (MUN), water contact recreation (REC-1) non-contact water recreation (REC-2), and agricultural water supply (AGR).

To protect these beneficial uses the Basin Plan contains both numeric and narrative water quality objectives. Numeric water quality objectives are included through the Basin Plan's chemical constituents objective, which include California Department of Public Health (DPH) primary and secondary Maximum Contaminant Levels (MCLs) and site-specific trace element water quality objectives (see Table 1).

Table 1 – Water Quality Objectives and Effluent and Sacramento River Concentrations

Parameter	Lowest Criteria (Human Health)	Effluent		R-1 (Sacramento River above the discharge)		River Mile 44 (Sacramento River 2 miles below the discharge where river is completely mixed)	
		Median	Maximum	Median	Maximum	Median	Maximum
Ammonia mg/L	1.5 mg/L Taste & Odor Threshold[1]	24	45	0.1	1.3	0.19	0.42
Nitrate mg/L	10 mg/L Primary MCL	0.1	1.4	0.13[b]	0.42[b]	0.12[b]	0.44[b]
TKN mg/L	none	26	33	0.35[b]	0.89[b]	0.51	1.3
Total Nitrogen, mg/L	none	26	33	0.49	1.4	0.87	1.3
Phosphorus mg/L	none	2.35	3.3	0.062	2.8	0.14[b]	2.5[b]
Total Organic Carbon mg/L	none	17	32	2	5.5	2	6.6
Chloroform µg/L[2]	80 µg/L Primary MCL	14	51	0.5[a]	13	0.29	1.2
Dichlorobromomethane µg/L	0.41 µg/L CTR	0.9	2.5	ND	ND	ND	ND
Dibromochloromethane µg/L	0.56 µg/L CTR	0.216	0.7	ND	ND	ND	ND
Bromoform µg/L	4.3 µg/L CTR	0.159[a]	0.6	ND	ND	ND	ND
Nitrosodimethylamine µg/L	0.00069 µg/L CTR	ND	0.044	ND	ND	ND	ND
Giardia cysts/L	none	32	400	0.2	24	0.30[c]	8.5[c]
Cryptosporidium oocysts/L	none	4.1	88	0.3	0.5	0.1[c]	1.2[c]

a-less than 10% detection
b-Coordinated Monitoring Program (CMP) @ Freeport & River Mile 44
c-R-3 – Cliff's Marina approximately 1 mile downstream of the discharge
1 – Interpretation of Basin Plan taste and odor nar rative objective
2 - Chloroform included in total THM limit of 80 µg/L

In addition, numeric criteria from the US Environmental Protection Agency (USEPA) National Toxics Rule and California Toxic Rule criteria are used to implement the Basin Plan's narrative toxicity objective. The Basin Plan also includes the following narrative water quality objectives that relate to human health and/or drinking water issues:

- Water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses.

- Water shall not contain taste or odor producing su bstances in concentrations that impart undesirable tastes or odors to domestic or municipal water supplies or fish flesh

or other edible products or aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.

Federal Regulations mandate that NPDES permits include effluent limitations for all pollutants that are or may be discharged at levels that cause or have a reasonable potential to cause or contribute to an exceedance of a water quality standard, including numeric and narrative objectives within a standard. Where reasonable potential exists for a pollutant, but there is no numeric criterion or objective for the pollutant, water quality-based effluent limitations (WQBELs) must be established using: (1) USEPA criteria guidance under the Clean Water Act (CWA) Section 304(a), supplemented where necessary by other relevant information; (2) an indicator parameter for the pollutant of concern; or (3) a calculated numeric water quality criterion, such as a proposed State criterion or policy interpreting the State's narrative criterion[2].

The Central Valley Drinking Water Policy Workgroup is examining constituents of concern and developing numeric water quality objectives to protect drinking water sources. The Drinking Water Policy is expected to be completed in 2010, but due to a lack of information it is likely it will only include monitoring requirements for constituents of concern, not numeric water quality objectives that could be used to set regulatory requirements in NPDES permits.

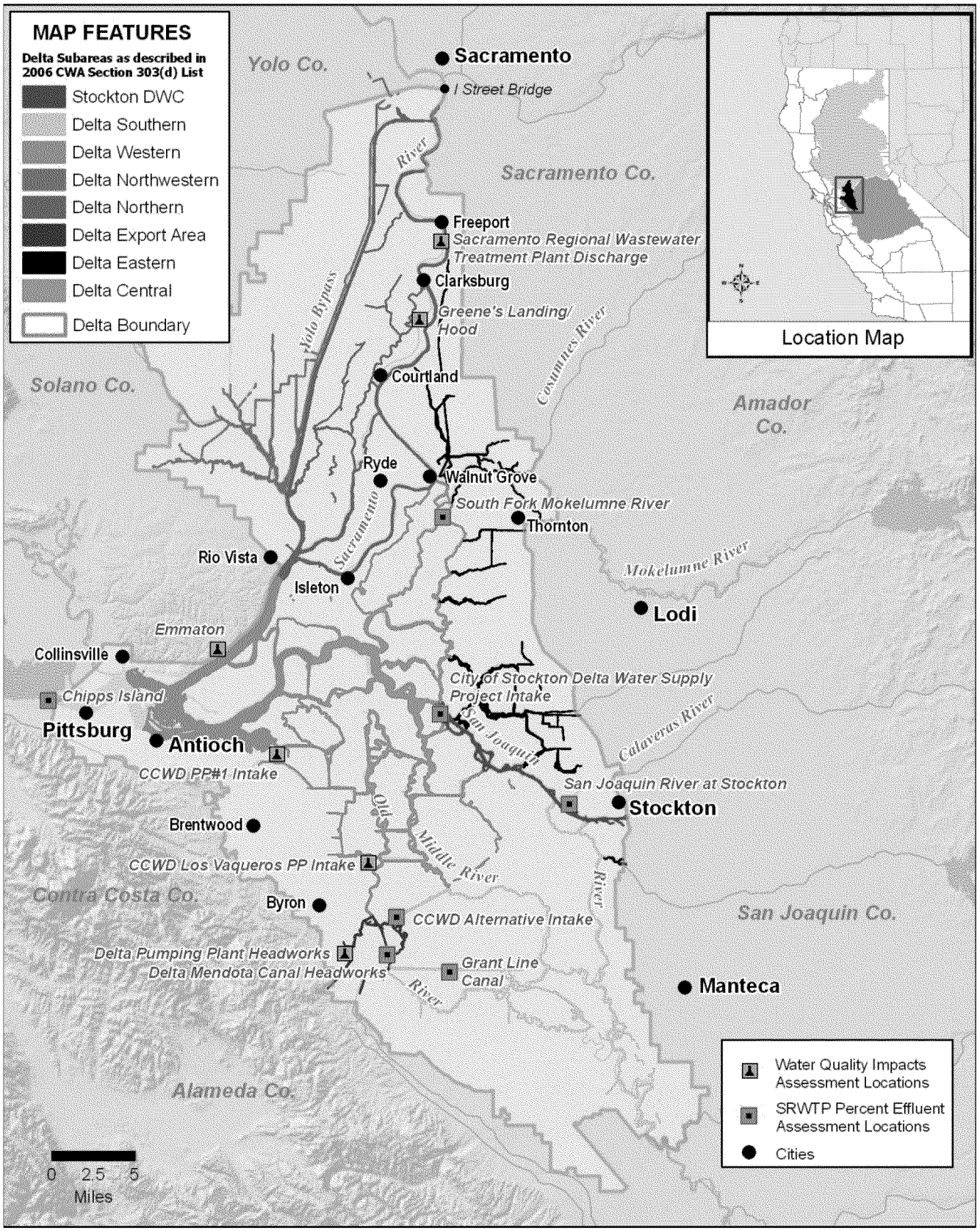
Drinking Water Supply Issues

The nearest drinking water intake to the SRWTP discharge to the Sacramento River is the East Bay Municipal Utility District's (EBMUD) Freeport Intake, approximately 1 mile upstream of the District's discharge. Under low river flow and high tides, effluent could move up river to the vicinity of the Freeport Intake. An operational agreement between SRCSD and EBMUD requires the diversion at the intake to cease during these conditions, so there should be no water quality impact intake. No further evaluation of the impact on the diversion is planned.

For the SRWTP discharge, the drinking water supply issues are primarily far-field issues that are experienced many miles downstream and throughout the Delta. To evaluate far-field impacts, the SRCSD created a far-field computer model based on the U.S. Bureau of Reclamation's Project Simulation Model (PROSIM) and the Fischer Delta Model (FDM). These models were used to determine the percentage of SRWTP effluent at several locations throughout the Delta. The locations represent drinking water intakes or water quality standard compliance locations and were used to collectively characterize water quality effects throughout the Delta. These locations include the Sacramento River at Greene's Landing/Hood; Emmaton; CCWD's Pumping Plant #1 on Rock Slough; CCWD's Los Vaqueros Intake on Old River at Highway 4; City of Stockton proposed Intake; Delta Pumping Plant Headworks, and the Delta Mendota Canal (See Figure 2).

[2] Water Quality Control Plan for the Sacramento Rive r and the San Joaquin River Basins and 40 CFR 122.44(d)(1) (vi) (A), (B) or (C)), or (3).

Figure 2 – Water Quality Impact and Assessment Locations



These models have been used to estimate the volume of SRWTP effluent (effluent fraction) at these select locations at the current flows (141 mgd), currently permitted discharge (181 mgd) and with the expanded discharge of 218 mgd. (See Table 2)

Table 2: Daily Average SRWTP Effluent Fractions (%) at Delta Locations

	Greens Landing/ Hood	Sacramento River @ Emmaton	San Joaquin River @ Stockton	CCWD @ Rock Slough	Los Vaqueros Intake	Banks Delta Pumping Plant	Delta Mendota Canal Headworks
141 mgd (existing flow)	1.45	1.26	0.09	1.09	1.0	0.97	0.6
181 mgd (existing permit)	1.86	1.63	0.12	1.41	1.3	1.25	0.78
218 mgd (future flow)	2.24	1.95	0.14	1.69	1.56	1.5	0.93

The far-field drinking water supply issues identified in this document are impacts due to nutrients, total organic carbon, salts and pathogens, as discussed below.

Drinking Water Issue 1 – Nutrients

Issue – Numeric water quality objectives to address biostimulation caused by excessive nutrients are not currently established. Therefore, it is difficult to evaluate the impacts of the current or increased SRWTP discharge on the beneficial uses of the Delta at far-field drinking water intakes due to the biostimulation effects of nutrient loading. At this time it is uncertain whether nutrient loadings from the current permitted or expanded discharge are impacting beneficial uses due to biostimulation. Without numeric water quality objectives, should and how does the Central Valley Water Board address the issue of nutrients in the discharge?

Background – Nutrients that are inherent to discharges from municipal wastewater treatment plants include nitrogen and phosphorus, which are discharged by the SRWTP. Nutrients stimulate algal growth and are essential to the health and diversity of surface water bodies. However, excessive algal growth can impact the use of water for municipal and domestic supply on several levels. Algal growth can impact the efficiency of water treatment filters, create taste and odor issues, increase total organic carbon, which is a precursor to the formation of trihalomethanes (cancer causing constituents), and certain species of algae produce neurotoxins that are harmful to humans, fish, and wildlife. The Basin Plan contains a narrative objective that states "Water shall not contain biostimulatory substances which promote aquatic growths in concentrations that cause nuisance or adversely affect beneficial uses." Currently, the Basin Plan does not contain numeric water quality objectives for phosphorus and nitrogen as biostimulating substances.

Excessive algal growth in the Delta may result in increased concentrations of total organic carbon. Elevated total organic carbon negatively impacts municipal drinking water suppliers, because it may result in the creation of harmful byproducts during chlorination, if the total organic carbon is not removed through prior treatment steps. High algae levels in source water can also impact water treatment plants, because algae can clog filters and reduce the efficiency of filtration.

Some species of bluegreen algae are associated with the production of compounds such as geosmin and 2-methylisoborneol (MIB) that impart objectionable odors and tastes to waters, even at very low concentrations. Taste and odor problems may be resolved with algaecides. But the predominant algaecides are copper-based, which creates solid waste disposal problems as well as aquatic toxicity issues. Other species of blue green algae, in particular *Anabaena flos-aquae, Microcystis aeruginosa, and Aphanizomenon flos-aquae*, produce neurotoxins that are toxic to humans, fish, and wildlife. Most of the problems associated with these deadly species of algae are located in the Klammath River Basin. However, these species of algae have also been reported in the Delta according to the Department of Public Health. There is some conjecture that ammonia may favor *Mycrocystis* growth, increasing the threat of toxicity impacts from algae.

Although there are no state or federal numerical standards for nutrients, the USEPA has developed recommended nutrient levels for total nitrogen and total phosphorous that indicate levels of these nutrients that can create a high risks for eutrophication. USEPA's Aggregate Ecoregion 1[3] that includes the Delta are 0.055 mg/L for total phosphorus and 0.66 mg/L for total nitrogen[4]. These recommended levels generally represent nutrient levels that protect against the adverse effects of nutrient over-enrichment. EPA has developed these recommendations as starting points for States and authorized Tribes to develop more refined nutrient criteria. At this time there are no state or federal numeric water quality standards for nutrients to limit biostimulation for use in NPDES permitting. However, the State Water Resources Control Board is developing a tool to assist the Regional Boards in development of site-specific nutrient requirements.

The SRWTP effluent total phosphorus averages 2.3 mg/L and the effluent total nitrogen averages 24.3 mg/L, contributing to a substantial amount of nutrients to the river. The following table compares the USEPA recommended nutrient concentrations and the average and maximum effluent and river concentrations:

[3] Ecoregion 1 includes both the Willamette Valley in Oregon and the Central Valley in California.

[4] Nutrient Criteria Development; Notice of Ecoregion al Nutrient Criteria, January 6, 2003 (Volume 68, N umber 3)

Table 3 – Nutrient Recommendations, Effluent Concentrations & Sacramento River Concentrations

	EPA Recommendation median	Average Effluent Concentration	Maximum Effluent Concentration	Average Upstream Sacramento River Conc	Maximum Upstream Sacramento River Conc
Total Phosphorus mg/L	0.055	2.3	3.3	0.11	2.8
Total Nitrogen mg/L as N	0.66	24.3	33	0.65	1.4

When evaluating the impact of nutrients on beneficial uses due to eutrophication, nutrient loading is not the only factor to consider. This is because algal productivity depends on several additional factors such as morphology, light availability, flooding frequency, biological community structure, etc. The Delta is light limited, which reduces algal productivity. However, when drinking water agencies transfer Delta water to storage reservoirs or water conveyance facilities (e.g., California Aqueduct) that are not light limited, algal blooms have been known to occur. This indicates that at times the MUN beneficial use is impacted (i.e., there is no assimilative capacity for nutrients in the Delta). Therefore, any additional loadings of nutrients could exacerbate the problem.

The predominant forms of nitrogen found in municipal wastewater are ammonia and nitrate. Removal of ammonia and nitrate (i.e. nitrification/de-nitrification) are becoming more common at POTWs that discharge to surface waters in order to protect the beneficial uses of the receiving waters. Ammonia is extremely toxic to aquatic life at low levels. Nitrate causes adverse health effects in humans by interfering with the transport of oxygen in the bloodstream, particularly with fetuses and newborn children, a condition known as methemoglobenemia, or blue-baby syndrome. Effluent limitations for ammonia and nitrate are not included in the existing NPDES permit for the SRWTP discharge, due to dilution of effluent in the Sacramento River. Nitrification/de-nitrification would likely require major modifications at the SRWTP because the pure oxygen activated sludge process is not conducive to nitrification due to the short detention times in the aeration basins. Phosphorus removal treatment is possible, but is not a common treatment process.

Permitting Options

The following are the basis for permitting options for consideration in the proposed NPDES permit:

1. Nutrient loadings at current permitted and expan ded discharge flows are not impacting beneficial uses. SRCSD permit requirements remain the same as the current permit without requirements for nutrient removal to address biostimulatory impacts. The existing NPDES permit does not have limitations for nutrients.

2. Nutrient loadings at current permitted discharge flow rate are not impacting beneficial uses, but may be problem at expanded flow. SRCSD permit requirements could address nutrient loading by requiring a mass limit for total nitrogen and phophorus, based on the current total nitrogen and phosphorus loading at 141 mgd or limit total nitrogen at the existing permitted flow of 181 mgd.

3. Nutrient loadings at current permitted and expan ded discharge flows are impacting beneficial uses. SRCSD permit requirements limit nutrient loading by requiring ammonia, nitrate and phosphorus removal for all flows (218 mgd) discharged based on an interpretation of the Basin Plan's narrative objective(s) or the primary MCL.

Drinking Water Issue 2 – Total Organic Carbon (TOC)

Issue –The SRWTP wastewater discharge contains TOC which is a precursor for the formation of cancer causing trihalomethanes. There are no numeric water quality objectives for TOC, thus it is difficult to evaluate the impacts of the current or expanded SRWTP discharge on the beneficial uses of the Delta at far field drinking water intakes due to TOC. Without numeric water quality objectives, should and how does the Central Valley Water Board address the issue of TOC in the discharge?

Background – During the chlorination disinfection process at drinking water treatment plants, organic carbon reacts with chlorine to form trihalomethanes or THMs (i.e. bromoform, chloroform, dichlorobromomethane and chlorodibromomethane), haloacetic acids (specifically monochloroacetic, dichloroacetic, trichloroacetic, monobromoacetic and dibromoacetic acids), and other disinfection byproducts (DBPs). Drinking water treatment plants are required to remove excess levels of TOC prior to disinfection to prevent the formation of the chlorine disinfection byproducts (see Table 3 below). Currently, numeric receiving water quality criteria are not available for TOC. However, the CALFED Programmatic Record of Decision, August 28, 2000 recommends:

> "(a) average concentrations at Clifton Court Forebay and other southern and central Delta drinking water intakes of 50 ug/L bromide and 3.0 mg/L total organic carbon, or (b) an equivalent level of public health protection using a cost effective combination of alternative source waters, source control and treatment technologies."

The SRWTP discharges an average concentration of 17 mg/L of TOC. The average effluent concentration of alkalinity as $CaCO_3$ is 136 mg/L. Some of the typical wastewater treatment processes to reduce TOC include (1) coagulation, flocculation, and filtration, (2) chemically enhanced primary settling or (3) granulated activated carbon filtration.

The source water TOC and alkalinity determines the drinking water treatment regime based on EPA's Stage 1 Disinfectants and Disinfection Byproducts Rule. Drinking water treatment plants are required to reduce TOC to minimize the formation of DBPs as shown in the table below.

Table 4 - Stage 1 Disinfectants and Disinfection Byproducts Rule - Percent TOC Removal Requirements

Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60 – 120	>120
>2.0 – 4.0	35.0%	25.0%	15.0%
>4.0 – 8.0	45.0%	35.0%	25.0%
>8.0	50.0%	40.0%	30.0%

Table 5 – Current TOC Levels at Delta Drinking Water Pumping Locations

Locations	Mean TOC (mg/L)	
	Current	SRWTP at 218 mgd
Delta Pumping Plant	4.17	4.24
CCWD Los Vaqueros	3.94	4.01
CCWD PP#1	3.75	3.84

As shown in Table 5, the TOC levels at several Delta drinking water pumping locations are currently at levels that require some level of treatment to remove TOC prior to disinfection. The SRWTP discharge only comprises a small fraction of the TOC at these locations. However, any addition of TOC exacerbates the problem and in some cases the SRWTP expanded discharge to 218 mgd may cause the TOC to increase to the next level of treatment required by the Stage 1 Disinfectants and Disinfection Byproducts Rule (e.g., CCWD Los Vaqueros).

To address the TOC concentrations in the State Water Project water from the Delta, the Metropolitan Water District of Southern California expects to spend $750 million by 2009 to prevent formation of DBPs in its drinking water by changing its method of disinfection from chlorination to ozonation at many of its water treatment plants. The costs to reduce TOC in the SRWTP effluent have not been provided.

Permitting Options –

The following are the basis for permitting options for consideration in the proposed NPDES permit:

1. TOC loadings at current permitted and expanded d ischarge flows are not impacting beneficial uses. SRCSD permit requirements remain the same as the current permit without requirements for TOC removal. The existing NPDES permit does not have limitations for TOC.

2. TOC loadings at current permitted discharge flow rate are not impacting beneficial uses, but may be problem at expanded flow. SRCSD permit requirements remain the same but limiting the TOC loading to current levels. The permit could require a mass limit for TOC, based on the current TOC loading at 141 mgd or a mass limit based on the current permitted flow of 181 mgd.

3. TOC loadings at current permitted and expanded d ischarge flows are impacting beneficial uses. SRCSD permit requirements include water quality based effluent limitations for TOC for all flows, 218 mgd. The permit could require a concentration-based limit for TOC, based on an interpretation of the Basin Plan's narrative objective(s).

Drinking Water Issue 3 – Pathogens

Issue – There are no receiving numeric water quality objectives for pathogenic protozoans such as *Cryptosporidium* and *Giardia*, thus it is difficult to evaluate the impacts of the current or expanded SRWTP discharge on the beneficial uses of the Delta at far field drinking water intakes due to these protozoans. Without numeric water quality objective, should and how does the Central Valley Water Board address the issue of pathogenic protozoans in the discharge?

Background – Pathogens include bacterium, viruses and protozoans, which exist in natural waters and wastewater. Pathogens are difficult to detect, because of the typically low abundance in most waters. Therefore, indicator bacteria (e.g., total coliform organisms) are used as a barometer of water quality. NPDES permits include total coliform limitations to measure the effectiveness of disinfection processes. Specific protozoans of concern for the Central Valley Drinking Water Group are *Giardia* and *Cryptospordium* from human and animal fecal waste. Both protozoans are in municipal wastewater and can cause diarrhea, vomiting and cramps. For immuno suppressed individuals, the illness can be very serious, including death. There are no numeric water quality objectives for *Cryptosporidium* or *Giardia* to protect public health. However, DPH has developed drinking water source requirements. For drinking water, similar to TOC, the level or pathogens measured in source waters determine the drinking water treatment level necessary by setting log removal requirements as presented below.

Table 6 - Bin Classification[5] and Action Requirements

Bin Classification	Maximum Running Annual Average (oocysts/L)	Action Required (log removal)
1	<0.075	none
2	0.075 to <1.0	1
3	1.0 to <3.0	2
4	≥ 3.0	2.5

Coliform and viruses are successfully killed with chlorine disinfection. Chlorine is most effective when the treatment also includes coagulation, flocculation and filtration (tertiary treatment), because with filtration there are less solids that can interfere with the chlorine disinfection process. However, chlorine is not as effective in killing protozoa, because protozoa are resistant to chlorine. Therefore, when chlorine disinfection is used, low coliform concentrations in wastewater treatment effluents do not guarantee absence of protozoans. Technical literature is very clear that *Cryptosporidium* oocysts and *Giardia*

[5] Grouping of source water by concentration of *Cryptosporidium.*

cysts are resistant to chlorine disinfection and relatively high concentrations can be observed in wastewater treatment plant effluents that use chlorine disinfection. The treatment of protozoans is challenging, as cysts and oocysts of protozoans cannot be fully removed by sand filtration and are resistant to chemical disinfection. Disinfection using ultraviolet (UV) light deactivation after tertiary treatment was found to be more effective in deactivating *Giardia* and *Cryptosporidium*.

Illness from *Giardia* can occur with a median dose of 10 cysts, while illness can occur from *Cryptosporidium* from a median dose ranging from 10 – 100 oocysts[6]. Available effluent data from the SRWTP for the period of January 1997 through April 2006 indicate the presence of *Giardia* ranging from 2-400 oocyst/L and *Cryptosporidium* ranging from 0.08-84 cysts/L. Median and mean concentrations observed at the SRWTP are 4.1 and 9.3 cysts/L for *Cryptosporidium* and 32.5 and 41.6 oocyst for *Giardia*, respectively. These values are tempered by the test methodologies inability to distinguish between viable and non-viable protozoans.

Permitting Options –

The following are the basis for permitting options for consideration in the proposed NPDES permit:

1. Protozoan loadings at current permitted and expa nded discharge flows are not impacting beneficial uses. Disinfection requirements remain the same as the current permit, which is no limitations for *giardia* or *cryptosporidium*, but include monitoring and/or special studies for pathogenic protozoans.

2. Protozoan loadings at current permitted discharg e flow rate are not impacting beneficial uses, but may be problem at expanded flow. Disinfection requirements remain the same for existing flows (141 mgd) or permitted flow (181 mgd) but require additional treatment to reduce protozoans below illness dosage for the increased flows to 218 mgd.

3. Protozoan loadings at current permitted and expa nded discharge flows are impacting beneficial uses. Disinfection requirements include additional treatment to reduce protozoans below illness dosage for all flows (218 mgd) discharged.

Drinking Water Issue 4 – Salinity

Issue – Salinity is a serious issue for the Delta, with many of the Delta waterways impaired for salinity. The effluent salinity for the SRWTP is relatively low for a POTW. The effluent salinity is less than all applicable numeric salinity water quality objectives and the concentration of salinity is not expected to increase with increased flows. However, with the increased flow, the SRWTP will be adding an additional mass load of salt to the Delta, which may exacerbate the salinity problems in the Delta. Therefore, are effluent

[6] "Conceptual Model for Pathogens and Pathogen Indic ators in the Central Valley and Sacramento-San Joaquin Delta", August 24, 2007, Prepared for US En vironmental Protection Agency, Region IX and Central Valley Drinking Water Policy Workgroup,Tetr a Tech .

limitations or other requirements for salinity needed to control the salinity of the SRWTP discharge?

Background – The SRWTP discharge contains total dissolved solids (TDS), chloride, sulfate, and electrical conductivity (EC). These are water quality parameters that are indicative of the salinity of the water. Their presence in water can be growth limiting to certain agricultural crops and can affect the taste of water for human consumption. The Basin Plan contains a chemical constituent objective that incorporates State MCLs, contains a narrative objective, and contains numeric water quality objectives for EC, TDS, sulfate, and chloride. Table 7 below summarizes salinity water quality objectives/criteria and effluent concentration values.

Table 7. Salinity Water Quality Criteria/Objectives and Effluent Concentrations

Parameter	Bay Delta Plan Compliance Standards (lowest)	Agricultural WQ Goal[1]	Secondary MCL[2]	EPA NAWQC[4]	Effluent	
					Ave	Max
EC (µmhos/cm)	450 Sac River @ Emmaton	Varies[3]	900, 1600, 2200	--	763	960
TDS (mg/L)	--	Varies	500, 1000, 1500	--	416	540
Sulfate (mg/L)	--	Varies	250, 500, 600	--	96	110
Chloride (mg/L)	150 CCC#1	Varies	250, 500, 600	230 (4-day) 860 (1-hour)	91	100

[1] Agricultural water quality goals based on *Water Quality for Agriculture*, Food and Agriculture Organization of the United Nations—Irrigation and Drainage Paper No. 29, Rev. 1 (R.S. Ayers and D.W. Westcot, Rome, 1985)

[2] The secondary MCLs are stated as a recommended level, upper level, and a short-term maximum level.

[3] The EC level in irrigation water that harms crop production depends on the crop type, soil type, irrigation methods, rainfall, and other factors. An EC level of 700 umhos/cm is generally considered to present no risk of salinity impacts to crops. However, many crops are grown successfully with higher salinities.

[4] USEPA's National Ambient Water Quality Criteria for the protection of freshwater aquatic life.

MWD and Zone 7 of the Alameda County Flood Control and Conservation District, two large water purveyors in California also have a target goal for Delta source water that is lower than the applicable receiving water salinity objectives. They blend Delta source water with either the more saline Colorado River water or groundwater to deliver to their customers, so they need lower salinity Delta water.

The Sacramento River's mean mass load of salt to the Delta is 1,945,000 tons per year.[7] Currently, the SRWTP's effluent does not cause the Sacramento River to exceed the numeric water quality objectives as described in Table 7, above.

[7] "Salinity in the Central Valley", Central Valley Regional Water Quality Control Board, May 2006.

There are two common methods to reduce salt in wastewater effluent. The first is to reduce the amount of salt flowing to the wastewater treatment plant. This is generally, accomplished by restricting industrial salt discharges to the wastewater treatment plants, eliminating residential water softeners, and through the use of a low salinity water supply. The other method is wastewater treatment by reverse osmosis or other technologies. Reverse osmosis is a very expensive and energy intensive treatment that uses membrane technology. Not only is reverse osmosis expensive, but disposal of the byproduct of concentrated brine is a problem. Due to the costs of reverse osmosis, no municipal wastewater treatment plants in the Central Valley currently use this treatment. Costs for reverse osmosis treatment at SRWTP have not been provided.

Permitting Options –

The following are the basis for permitting options for consideration in the proposed NPDES permit:

1. Salinity loadings at current permitted and expan ded discharge flows are not impacting beneficial uses. SRCSD permit requirements remain the same as the current permit without requirements for salinity removal. The existing NPDES permit does not have limitations for salinity.

2. Salinity loadings at current permitted discharge flow rate are not impacting beneficial uses, but may be problem at expanded flow. SRCSD permit requirements remain the same but limiting the salinity loading to current levels. The permit could require a mass limit for TDS, based on the current TDS loading at 141 mgd or a mass limit based on the current permitted flow of 181 mgd.

3. Salinity loadings at current permitted and expan ded discharge flows are impacting beneficial uses. SRCSD permit requirements include water quality based effluent limitations for salinity for all flows, 218 mgd. The permit could require a concentration-based limit for TDS or EC, based on an interpretation of the Basin Plan's narrative objective(s).

Drinking Water Issue 5 - Contaminants of Emerging Concern

Issue – Should Contaminants of Emerging Concern (CECs) be regulated under the renewed NPDES permit? Alternatively, should the renewed permit require monitoring of CECs?

Background – Pharmaceuticals, personal care products and endocrine disrupting chemicals are referred to as contaminants of emerging concern (CECs). With advances in analytical chemistry it is now possible to detect these chemicals in treated wastewater. CECs include prescription and nonprescription drugs, soaps, fragrances, hair spray, finger nail polish, cosmetics, oral contraceptives, insect repellant and sunscreen. Pharmaceuticals are found in wastewater effluent at very low concentrations. The human health effects from these constituents in source water is unknown. Currently there are several studies on the long-term effects of CECs, additive toxicity and treatment.

Potential treatment processes to remove or inactivate these constituents include free chlorine disinfection, ozonation, ultraviolet light (UV) irradiation, activated carbon, reverse osmosis and nanofiltration. However, the effectiveness of these treatment processes is unknown.

With the state of knowledge regarding CECs incomplete, there needs to be additional research and development of analytical methods and surrogates to determine potential environmental and public health impacts. All agencies should minimize the likelihood of CECs impacting human health and the environment by means of source control and/or pollution prevention programs. Until such time, regulating most CECs will require significant work to develop test methods and more specific determinations as to how and at what level CECs impact public health or our environment.

Based on the information stated above no effluent limitations are required at any wastewater treatment facilities in the Central Valley for CEC at this time At this time no regulatory requirement are proposed for the SRCSD NPDES permit renewal. As required by the Recycled Water Policy, SWRCB has established the Advisory Panel on Constituents of Emerging Concerns. It is anticipated that the Panel's recommendations will provide guidance for monitoring and possible regulation of CECs. A reopener will be included in the NPDES permit.

Disinfection Issue 1 – Pathogens

Issue – For the protection of public health from the contact with pathogens in the wastewater discharge, the existing permit requires total coliform organism limitations that are equivalent to secondary disinfection requirements recommended by DPH. Are these disinfection requirements appropriate for the level of exposure in the river?

Background – Adequate disinfection of the SRWTP wastewater to remove pathogens is necessary to protect the health of people using Sacramento River water, including use of river water for agricultural irrigation, contact and non-contact recreation, and municipal and domestic supply. River water containing diluted SRWTP effluent is used for irrigation of food crops, will come into contact with agricultural workers, will contact and be ingested by recreational users, and is diverted as domestic and municipal water supply for many communities.

Unique to the Sacramento River at the point of discharge are the tidal flows that slow the river flow, and at times cause flow reversals. The existing NPDES permit adopted in 2000, prohibits river discharge when the flow ratio (Sacramento River: effluent) is less than 14:1. The existing permit also prohibits discharge when river flows are less than 1,300 cubic feet per second (cfs). These discharge prohibitions are based on the design of the effluent diffuser to ensure adequate mixing of effluent with river water. When either of these two conditions exists, the SRCSD ceases its surface water discharge and diverts treated effluent to storage basins. Operational conditions for the diffuser prevent undiluted effluent from reaching the river surface, although the effluent will only be partially mixed with the river when effluent/river mixtures reach the river surface, as discussed further below.

Total coliform organism effluent limits are included in NPDES permits to ensure adequate pathogen removal to protect the beneficial uses of the receiving water, including contact recreation and agricultural irrigation. In a letter to the Regional Water Board dated 8 April 1999, the California Department of Health Services (now Department of Public Health or DPH) indicated that DPH would consider wastewater discharged to water bodies with identified beneficial uses of irrigation or contact recreation and where the wastewater receives dilution of more than 20:1 to be adequately disinfected if the effluent total coliform organism level does not exceed 23 MPN/100 mL as a 7-day median and 240 MPN/100 mL more than once in any 30 day period. Furthermore, the DPH provided a letter dated 1 July 2003 that included clarification of the recommendations. The letter states, "*A filtered and disinfected effluent should be required in situations where critical beneficial uses (i.e. food crop irrigation or body contact recreation) are made of the receiving waters unless a 20:1 dilution ration (DR) is available. In these circumstances, a secondary, 23 MPN discharge is acceptable.*" In addition, for MUN-designated water bodies, DPH has not recommended treatment beyond secondary with 20:1 dilution, or tertiary without 20:1 dilution, where there were no known users of untreated water near a treatment plant outfall. DPH is reviewing the information for this discharge for adequate disinfection.

Although the dilution normally exceeds 20:1 after complete mixing, which occurs 1-2 miles downstream of the discharge, based on modeling by the SRCSD, it appears there is the potential of public contact with partially diluted wastewater within the near field mixing zone. Table 8 illustrates the average dilutions within the discharge plume for varying effluent and river flow conditions based on modeling by the SRCSD. The modeling is not for any particular effluent discharge rate; rather it is based on effluent:river flow ratios. For example, the average dilution within the discharge plume 500 feet downstream of the outfall is 8.7:1 (approximately 10% effluent) at a flow ratio of 14:1 (i.e. the minimum flow ratio allowed for a surface water discharge). Flow ratios nearing 14:1 are not uncommon during dry years. For example, from January 2007 through June 2008, the SRCSD frequently diverted effluent to its storage basins (over 137 diversions), because the Sacramento River flows were not sufficient to meet the minimum 14:1 flow ratio required in the NPDES permit at some point in the tidal cycle.

Table 8 - Average dilution within the plume[a]

Flow ratio, (river: effluent)	Average Dilution Parts river to parts effluent
50 feet downstream	
(14:1)	1.9
(25:1)	2.8
(50:1)	5.3
(100:1)	10.6
175 feet downstream	
(14:1)	4.3
(25:1)	8.3
(50:1)	15.1
(100:1)	27.7
300 feet downstream	
(14:1)	6.6
(25:1)	12.5
(50:1)	23.2
(100:1)	39.5
500 feet downstream	
(14:1)	8.7
(25:1)	16.1
(50:1)	30.0
(100:1)	51.8

Proposed Effluent Discharge = 218 mgd or 337 cfs

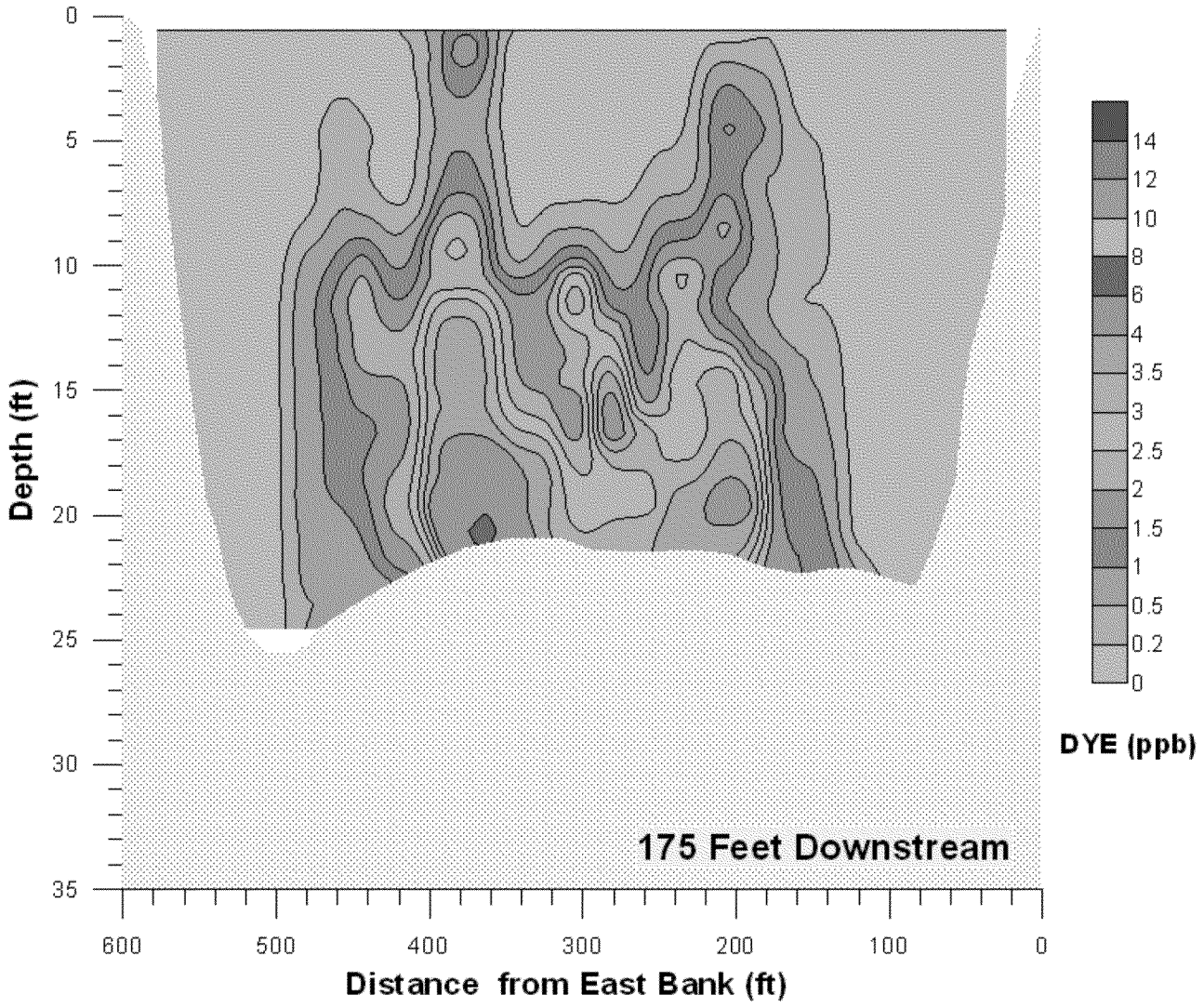
Water Years 1948-2002 (flow ratio at 218 mgd)
1Q10 flow = 3,729 cfs (11:1)
7Q10 = 3,968 cfs (12:1)
Harmonic mean flow = 10,064 cfs (30:1)

a – Figure 4 below illustrates a plume with varying concentrations of effluent.

Figure 4 depicts an illustration of the discharge plume and shows that the actual dilution varies throughout the discharge plume, with areas of higher and lower effluent concentrations within the plume. Additional figures are available for different distances downstream of the discharge and at differing river flows. At low river flows, diluted effluent surfaces close to the diffuser and diluted effluent hugs the east bank. The SRCSD has reduced the accumulation of effluent on the east bank by closing 25 ports on

the east side of the diffuser. This has reduced the accumulation, but has not eliminated it entirely.

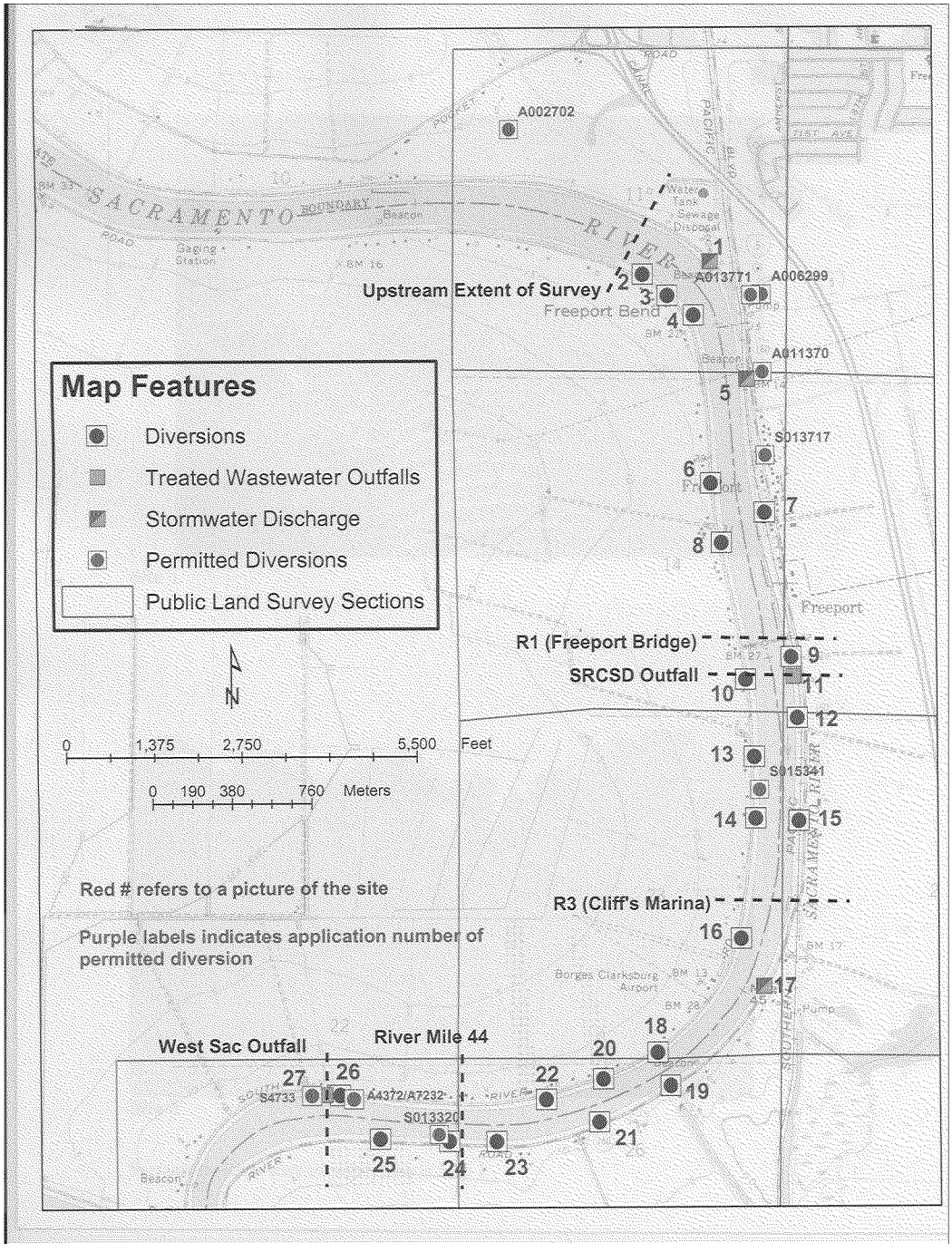
Figure 4 – Example of Plume Concentrations that are averaged to create data for Table 8.



The Sacramento River near the diffuser is a popular sport fishing area. In addition, there are at least 25 agricultural diversions within 1 mile upstream and 2 miles downstream of the discharge. See Figure 3 for water diversions in the vicinity of the diffuser. Based upon information submitted by SRCSD, the typical construction of the agricultural irrigation water intakes in the vicinity of the outfall would draw water from near the bank of the river, below the water surface (deep enough to not go dry during low river levels, but far enough from the river bottom to not be impacted by bottom sediments). It appears that undiluted effluent will not be drawn into the agricultural intakes, but varying mixtures of effluent and river water will be diverted from the partially mixed discharge plume. The nearest drinking water intake is approximately one mile upstream at the new Freeport water intake. An operating agreement between the East Bay Municipal Utility District and

SRCSD will prevent diversion of river water containing diluted treated wastewater at the Freeport water intake.

Figure 3 - Map of Water Diversions



Permit Options –

The following are the basis for permitting options for consideration in the proposed NPDES permit:

1. Pathogen loadings at current permitted and expan ded discharge flows are not impacting beneficial uses. Adequate dilution of the effluent in the receiving water is occurring at the current and expanded discharge. SRCSD permit requirements remain the same as the existing permit with secondary treatment (23 MPN/100 mL as a 7-day median and 500 MPN/100 mL as a daily maximum that can not be exceeded in two consecutive days).

2. Pathogen loadings at current permitted discharge flow rate are not impacting beneficial uses, but may be problem at expanded flow. Inadequate dilution of the effluent in the receiving water is occurring at the current and/or expanded discharge resulting in an unacceptable public health risk. SRCSD permit requires increased level of disinfection (e.g., Title 22, or equivalent, tertiary treated effluent).

3. Pathogen loadings at current permitted and expan ded discharge flows are impacting beneficial uses. Increasing the minimum flow ratio would result in adequate dilution. SRCSD permit requires current level of disinfection (i.e., secondary treated effluent), and requires a 20:1 minimum flow ratio (Sacramento River: Effluent) at all times. Alternatively, the renewed permit requires increased level of disinfection (e.g., Title 22, or equivalent, tertiary treated effluent) for current and expanded discharge.